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## DISPOSITIONAL GROUP AND SPECIAL FITNESS IN HAND-TO-HAND COMBAT. KICKBOXING EXERCISES AND PROFILED CIRCUIT TRAINING

*Tadeusz Ambroży, Juliusz Piwowarski, Mateusz Nowak*

### ABSTRACT

This article is a result of researches concerning influence of the elements of kickboxing and profiled circuit training on the overall fitness of members of dispositional groups, such as antiterrorists. Taking into account the special features necessary for such people, for the experiment we chose exercises that are the best to develop them. Members of dispositional groups need special preparation so they could efficiently fight with the offenders, who threat

the security. The research experiment described is of interdisciplinary character, as it regards an interdisciplinary branch of studies – securitology. Security studies, to develop the security culture, must be based on empiric researches and consists of practical elements, as there is no place for speculative theories of doubtful quality here. Therefore researches on special preparation of dispositional groups are of great importance.

### KEYWORDS

security culture, physical culture, counterterrorism, special preparation

### INTRODUCTION

This article contains considerations on technical and scientific problematic which concern aspects and application of physical culture. It regards rising of the efficiency of dispositional groups. More precisely, this problematic is associated with physical culture, which is examined from such a point of view that allows to find its securitological application based on methods developed within the practice and the theory of sport. We wanted to present a relevant fragment that is now more often present in scientific discourse and in publications concerning the phenomenon known around the world as security culture. This phenomenon is the subject of transdisciplinary researches concerning security issue. Physical culture is an element associated to endless toil of consecutive, taken up by newer and newer generations, reconstruction of specific patterns, methods, behaviors and every transmissions represented by the complementary security culture.

This phenomenon in both, conscious and unconscious way accompanies people since they resisted for the first time to various forms of

threats. For thousands of years people were creating and improving it, as they were fighting intensively for survival and development individually and in groups. In the process of building the security culture, very early appeared specialized groups of people, who had some adequate psychophysical predispositions and so-called moral (and volitional) dispositions to actively protect once their tribesmen, currently – fellow-countrymen. Nowadays we call them **dispositional groups**.

Physical and mental preparation of dispositional groups naturally required improvement of psychophysical preparation of their members for the possibility of taking up effective defense fight. This improvement was being intensified due to the pressure of time and existing threats. Stress is another factor that while facing the conflict, along with the existence of it, becomes of great activating meaning and this require no further substantiation. This way, man started his purposeful activity, which took place in the area of physical culture, but aimed to raise the level of security culture. We shall, looking closely at the historical sequence of aftermaths, agree that it was much later, when a sport variant of

physical culture appeared as a secondary effect of needs associated to the phenomenon of the culture of security and defense. In all fairness (which is one of the mental “artefacts” of security culture) one must notice that sport is now paying its historical “debts” to dispositional groups, which have initiated sport rivalry in antiquity. Sport offers the contemporary dispositional groups a greatly enriched, in relation to its “rough” variants, theoretical apparatus and practical tools. These tools are highly efficient training methods. *Kano paradox* is an example here. It led to improvement of combat *ju-jutsu*, which have a medieval origin, by raising the possibility of trainability of combat techniques in sport training of *judo*. It is similar when it comes to methods of capacity preparation – trainings of various forms of capacity, and finally strength trainings. Methods, which are very useful for preparation of members of dispositional groups, for instance counterterrorism divisions, are such disciplines as Euro-American boxing, Japanese karate and judo and a kickboxing training, which combines advantages of them, and MMA (*mixed martial arts*) skills.

Discussion on an influence of this training on raising of some capabilities of a counterterrorist or competitive sport contestant is the main part of this article and is based on actual scientific-research experiment. We mean the scientific researches of empirical character which were conducted in the Institute of Security and Socio-Legal Studies of School of Higher Education in Public and Individual Security “APEIRON” in Cracow. *Nota bene*, preparation of a uniformed service officer to direct combat as part of counterterrorism activity is, from a technical point of view, close to a training of a specific decathlon. However it is a subject for much wider elaboration, while in this article we focused on the topic specified in the title of the article and on the discussion on researches and conclusions concerning the course of kickboxing training process, and influence of such exercises on the organism of participant. Participants of the project were students of internal security, who had declared that they are determined to serve in special division of the police (anti-terrorist subdivisions), army or other uniformed service (i.e. Border Guard or Customs Service). Students, who took part in described scientific experiment,

have never competitively trained martial arts, however they have had a contact with karate or other variants of ju-jitsu. Their challenge was to raise their capabilities of *hand combat*. It was supposed to be done due to an intensive training of contact sport such as kickboxing with a focus on elements of the traditional boxing. This technique enables visible increase of competences regarding so called “distancing”, special hardiness characteristic for competitors, who are being “hit”, and raising the skill of efficient head protection, since the high “insecurity level” of this area of defense techniques practically eliminates the person as able to wage a hand combat at expected level. The skills we have indicated correlates with an excellent reaction time, agility and other components of speed (speed of a singular move, frequency of moves), which may be achieved through kickboxing and boxing training. A transfer that comes out of such abilities may be useful also for other actions than hand-to-hand combat. An example here is the so-called “quick eye”, a jargon term for a feature characteristic for well-trained boxers. This feature may be an useful element also when locating, judging the distance quickly, prioritization and making swift decisions, which allow to shoot moving objects that are the source of threats eliminated by an officer.

#### DESCRIPTION OF THE RESEARCH EXPERIMENT MECHANISM

To achieve a high technical level and strict sport or combat specialization, which means also out of sports needs regarding additional “armament” of those, who within their entire professional life live an *antiterror heavy duty style of life*, one needs to comprehensively develop general and special efficiency<sup>1</sup>.

One of the most challenging sport disciplines in motor shaping is boxing. So is its close relative – a discipline that combines a tried-and-true in self-defense, trained once by all respectable world armies – boxing and even older, tested in samurai war struggle – *karate*.

<sup>1</sup> L. Matwiejew 1967: *O problemach teorii i metodyki treningu sportowego*. Sport Wyczynowy 8(46): 21-26; Beachle T.R., Earle R.W. 2008: *Essentials of Strength Training and Conditioning*. Physiotherapy 83(1): 653.

This discipline is kickboxing, which requires “complete” and very high level of overall fitness of a person, who trains it. The course of a contact fight is characterized by a rapid and changing pace and large amount of kicks and (generally) relatively in relation to kicks, larger amount of punches. The field of a real fight with an offender in contrast to the ring usually limits the number of kicks in a way that is proportional to terrain difficulties and adverse weather condition, which may for example cause icing, strokes of wind, rain, fog, insufficient lightening of the battle field (none of this occurs in the ring). These elements only rise the bar for expected psychophysical competences of a counterterrorist, source of which is intensive, but at the same time wisely planned and properly carried out, sport (however at the same time of an out-of-sport character) physical training. Organism of a training person should be prepared for an effort of very high intensity, when the frequency of systole may exceed 190-200 beats per minute and the concentration of lactate may raise to 14-15 mmol<sup>-1</sup>.<sup>2</sup> Kickboxer mainly shapes their so-called explosive strength, which provides speed and powerful punches. This destructive energy may be an additional argument in the hands (and legs) of a well-trained antiterrorist. While planning the training, one should avoid isolated exercises for they would not have a functional quality for a kickboxer and the strength coming out of it cannot be used in a real contact fight.<sup>3</sup> In other words – it means that if a antiterrorist does too much of this exercises (it unfortunately happens often – the question is: who currently supervises that?) he may be unconsciously committing a suicide, which is only slightly postponed.

Due to multilateralism of tactical and technical physical preparation necessary for a counterterrorist, so-called general preparation is

of great importance, probably somewhat bigger than for a competitive athlete. To avoid misunderstanding – we are speaking of proportions which cause unfounded for a qualified sport but necessary for a counterterrorist volume increase and extension of the scope of all-purpose exercises (in relation to people who are narrow specialists in a given sport discipline). Extended elements of overall preparation are versatile basis not only for boxing, karate, and judo but also for other forms of physical activity, such as climbing, swimming or skiing. On the other hand the requirements of hand combat will optimize strength preparation by adoption for a standing fight a characteristic of load and motion specific adequate for kickboxing, whereas for the fight on the ground floor (to which in practice of anti-terrorist hand-to-hand combat one should not earnestly seek, as well as to handcuff the suspects on the ground) optimization of load should be the one, which is characteristic for judo. Both optimizations must avoid, as said and explained above, isolated forms of movement.

Numerous groups of muscles are engaged during punching and avoiding punches in kickboxing, therefore it seems to be recommendable to take into account polyarticular exercises with weights, medicine ball and the weight of one's own body. Strength preparation should also take regard to the planned time of a fight, when (if we think of sport confrontation during a sparring or sport competitions) for 2 or 3 minutes the strength of a competitor is used repeatedly without a single break for restoration of energy reserve. We need to remember that uniformed services also participate in internal, national and international sports rivalry. That's why, one should consider the time to shape strength efficiency during the preparation period, for example by using the circuit method<sup>4</sup>. On the basis of various variants of circuit trainings<sup>5</sup> we used the work-out of high-intensity small circuits (average frequency of systole in the range of 75-

<sup>2</sup> J.B. Nikiforow, I.B. Wiktorow 1974: *Metody treningowe w boksie*. Sport Wyczynowy 9(117): 23-26; Gosh A.K. 2010: *Heart rate, Oxygen Consumption and Blood Lactate Responses during Specific Training in Amateur Boxing*. International Journal of Applied Sports Sciences 22(1): 1-12.

<sup>3</sup> N. Bourne, J. Todd, T. Todd 2002: *The Cold War's Impact on the Evolution of Training Theory in Boxing*. The Journal of Physical Culture 7 (2-3): 26-30; M. Matthews, P. Comfort 2008: *Applying Complex Training Principles to Boxing: A Practical Approach*. Journal of Strength and Conditioning Research 30(5): 12-15;

<sup>4</sup> W.P. Ebben, D.G. Blackard 1997: *Developing a Strength-Power Program for Amateur Boxers*. Journal of Strength and Conditioning Research 19(1): 42-51;

<sup>5</sup> M. Scholich 1986: *Circuit training*. Wydawnictwo SportVerlag, Berlin; T. Ambroży 2007: *W poszukiwaniu związków treningu obwodowego z prozdrowotną aktywnością fizyczną*. Annales Medicina Wydawnictwo UMCS, Lublin.

85% HRmax). Performing the individual exercises in circuits was time-limited to 30 seconds, the break between the circuits was 1 minute. Selecting the exercises, we have been following the assumption that they had to be polyarticular and to engage numerous groups of muscles (emphasized lack of isolated exercises).

#### DATA AND METHOD

From among the volunteers selected were people of similar somatic parameters. During verification of the participants of the experiment, we have posed an assumption that they had to be men of no less than three and no more than five years of practice of active training, however not on a high level of competitive sport (they mustn't have neither first nor higher class in their discipline). This condition results from high intensity of proposed form of work-out, which requires an organism that is used to effort. Additionally the criterion defining the range of time of participation in specialized training allowed to select people of similar training degree and technical advancement in certain discipline. Using the purposeful selection in every group, we have chosen 30 people in the age group of 21 to 28 years. The first group (n=30) was performing the training previously practiced (called *the own training*), whereas the other one (n=30) acceded to the experimental cycle.

#### THE RESEARCH PROCEDURE USED

Motor skills of the participants of the experiment was tested before the project and seven days after the ending. It allowed to assess the scale of impact of the experimental work-outs on the organisms of examined students. Selection of the tests was verified by the training specificity of boxing and kickboxing.

Using the Eurofit fitness test and International Physical Fitness Test, following control samples were chosen:

#### A. Coordination capacities and speed of movements:

1. Static balance (*flamingo balance*).
2. Arm movements frequency (*plate tapping*).

#### B. Physical condition capabilities:

1. *Strength capabilities*:
  - dynamic strength of abdominal muscles: doing sit ups for 30 seconds
  - pull-ups
  - gripping force – measurement of a static strength
2. *Speed capabilities*:
  - explosive strength ( long jump from standstill)
  - shuttle run 10 x 5 m.
3. *Endurance capabilities*:
  - The Cooper test: a 12 minutes of continuous run.
4. *Suppleness capabilities*:
  - Forward flexion

❖ Additional special trial, suggested by a trainer of a group of boxers: speed of punches of upper limbs<sup>6</sup>.

Speed (frequency) of punches. A contestant punches from a fighting stance. Every examined person performs a combination consisted of two punches: a left straight punch to the head and a right straight punch to the thorax, without changing the designated distance. The shields to which he performs 30 of such combinations (a total of 60 punches) are being held on a constant height by another person. Noted is the time of performing 30 complete combinations of punches in seconds with an accuracy of 0,1 s.

#### STATISTIC ANALYSIS

Examined variables were analyzed using the statistical tools, such as:

an arithmetic mean ( $Am, \bar{X}$ ), standard deviation ( $Sd$ ) and a student's *t*-test.

<sup>6</sup> K. Sterkowicz 2003: *Testowanie sprawności specjalnej w Ju-Jitsu sportowym*. [w:] S. Sterkowicz, T. Ambroży (red.): *Ju-Jitsu sportowe: proces szkolenia (podręcznik trenera)*. Wydawnictwo European Association for Security, Kraków.

RESULTS

Tables 1 and 2 show the results of the experiment.

TABLE 1 Comparison of *pretest* and *posttest* measurements of the examined groups of boxers (the experimental cycle) paired samples of student's *t*-test

	PRETEST		POSTTEST		STUDENT'S T-TEST (df=29)			
	am. $\bar{X}$	sd	am. $\bar{X}$	sd	Differences between measurements		t	p
					Am.	sd		
COOPER TEST	2848,17	200,36	2964,83	188,09	-116,67	43,64	-14,644	0,000
PULL-UPS	11,73	4,18	13,97	4,10	-2,23	1,04	-11,762	0,000
SIT-UPS	24,30	3,79	26,53	3,67	-2,23	1,36	-9,017	0,000
LONG JUMP FROM STANDSTILL	210,10	10,35	214,33	10,34	-4,23	3,58	-6,479	0,000
HAND GRIPPING FORCE	52,07	6,80	52,80	6,50	-0,73	2,02	-1,992	0,056
SHUTTLE RUN	12,62	0,70	12,58	0,68	0,04	0,25	0,805	0,428
PLATE TAPPING	13,51	1,00	13,04	1,04	0,47	0,34	7,491	0,000
FORWARD FLEXION	11,77	4,53	13,23	4,61	-1,47	1,61	-4,980	0,000
BALANCE	4,17	1,12	3,80	0,76	0,37	0,93	2,164	0,039
STRAIGHT PUNCHES TEST	14,58	1,46	14,21	1,45	0,37	0,34	5,953	0,000

Paired samples of student's *t*-test indicates a statistically important impact of the experimental work-out on the results obtained in individual test of motor skills by the group of boxers.

**TABLE 2** Comparison of *pretest* and *posttest* measurements of examined control group – (the own trainings cycle); paired samples of student's *t*-test

	PRETEST		POSTTEST		STUDENT'S T-TEST (DF=29)			
	am. $\bar{X}$	sd	am. $\bar{X}$	sd	Differences between measurements		t	p
					śr.	sd		
COOPER TEST	2908,33	199,21	2903,67	197,14	4,67	24,32	1,051	0,302
PULL-UPS	12,00	4,43	12,27	4,59	-0,27	1,57	-0,928	0,361
SIT-UPS	25,63	3,98	24,97	4,24	0,67	1,12	3,247	0,003
LONG JUMP FROM STANDSTILL	211,07	11,69	212,13	10,83	-1,07	2,72	-2,151	0,040
HAND GRIPPING FORCE	52,03	6,29	52,33	6,46	-0,30	1,21	-1,361	0,184
SHUTTLE RUN	12,61	0,69	12,75	0,65	-0,14	0,22	-3,665	0,001
PLATE TAPPING	13,23	1,12	13,32	1,09	-0,09	0,24	-2,033	0,051
SEATED FORWARD FLEXION	12,13	5,79	12,67	4,99	-0,53	1,72	-1,702	0,100
BALANCE	4,23	1,36	4,27	1,17	-0,03	1,19	-0,154	0,879
STRAIGHT PUNCHES TEST	14,49	1,57	14,47	1,56	0,02	0,26	0,399	0,693

Paired samples of student's *t*-test indicates a statistically important impact of the experimental work-out on the results obtained in individual test of motor skills by the group of boxers.

## DISCUSSION

**After the ending of six-week cycle of experimental circuit training, the tests of motor skill were repeated. On the basis of available literature we made an attempt to assess them.**

Participants of kickboxing trainings, who also participated in the research experiment, have noticed improvement of results in the Cooper test. The observed tendency of changes confirms previous reports on positive influence of circuit method on the development of cardiorespiratory endurance<sup>7</sup>. It also allows to suspect that the increase of endurance after the experimental circuit training have contributed to increase of oxygen consumption capability (VO<sub>2</sub>max) of the organisms of training people.

Examining the influence of regular exercises on the strength of muscles and endurance, Laforest et al<sup>8</sup> proved that people, who systematically do physical exercises, notice greater muscle strength in comparison to those, who don't do any.

Basic test of static strength and explosive strength showed higher values after the end of the six-week training cycle. In researches of the influence of high intensity interval training, Chtara et al<sup>9</sup> obtained improvement in individual tests of explosive strength – the force. Probably the effects in shape of the development (increase) of strength capabilities of people, who participated, may be associated to using resistance exercises in the experimental circuit training.

MacDougall et al<sup>10</sup>, on the basis of their own research, stated that the effects of strength

training may be associated to development of two types of muscle fibers: slow-twitch and fast-twitch (ST and FT) in right proportions. Although a strength training is not considered a basic method for developing strength, it exhibits a positive influence on highly important for antiterrorists (unpredictable time, amount and stress causing level of individual confrontations) and necessary for athletes strength endurance<sup>11</sup>.

In result of experimental circuit training, kickboxers have noted an improvement of abdominal muscles and arm muscles strength. In the experimental training we used mostly polyarticular strength exercises that were supposed to engage numerous muscles groups, including postural muscles, which are responsible for the posture correction. The set included inter alia: squat with a barbell, swing, exercises with a gymnastic ball and *bosu* ball. Research on the impact of such exercises on individual groups of muscles shows greater activation of stabilizing muscles during training. Mostly strengthened were abdominal muscles, hip flexors and lower back<sup>12</sup>. Effects of the experimental training shows significant strengthening of these muscles, which is partially proved by the progress in the test of abdominal muscles strength of the people training. The result is important for the practice of developing motor efficiency of both athletes and officers (anti-terrorist). Every sequence of movement characteristic for certain discipline of sport requires also an effective work of deep stabilizing muscles and pelvis<sup>13</sup>.

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*immobilization on human muscle fibres.* European Journal of Applied Physiology 43(1): 25-34.

<sup>11</sup> M.A. Brentano, E.L. Cadore, E.M. Da Silva, A.B. Ambrosini, M. Coertjens, R. Petkowicz, I. Viero, L.F.M. Kruehl 2008 : *Physiological adaptations to strength and circuit training in postmenopausal women with bone loss.* The Journal of Strength & Conditioning Research 22(6): 1816-1825.

<sup>12</sup> R.F. Escamilla, C. Lewis, D. Bell, G. Bramblet, J. Daffron, S. Lambert, A. Pecson., R. Imamura, L. Paulos, J.R. Andrews 2010: *Core muscle activation during Swiss ball and traditional abdominal exercises.* The Journal of orthopaedic and sports physical therapy 40(5): 539-541.

<sup>13</sup> E.A. Andersson, J. Nilsson, Z. Ma, A. Thorstensson 1997: *Abdominal and hip flexor muscle activation during various training exercises.* European Journal Of Applied Physiology And Occupational Physiology 75(2): 115-123; Liebensson C. 2003: *Functional abdominal training.* Journal of Bodywork and Movement Therapies 7(2): 101-103; R.S Deane, J. W. Chow, M.D. Tillman, K.A. Fournier 2005: *Effects of hip flexor*

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<sup>7</sup> R.S. Taipale, J. A. Mikkola, A. Nummela, V. Vesterinen, B. Capostagno, S. Walker, D. Gitonga, W.J. Kreamer, K. Häkkinen 2010: *Strength training in endurance runners.* International Journal of Sports Medicine 31(7): 468-476

<sup>8</sup> S. Laforest S., St-Pierre M.D., J. Cyr, D. Gayton 1990: *Effects of age and regular exercise on muscle strength and endurance.* European journal of applied physiology and occupational physiology 60(2): 104-111.

<sup>9</sup> M. Chtara., A. Chaouachi, G.T. Levin, M. Chaouachi, M. Amri, P.B. Laursen 2008: *Effect of concurrent endurance and circuit resistance training sequence on muscular strength and power development.* The Journal of Strength & Conditioning Research 22(4): 1037-1045.

<sup>10</sup> J.D. MacDougall, G.C.B Elder, D.G., Sale, J.R. Moroz, J. R. Sutton 1980: *Effects of strength training and*



Due to applying the experimental training process, improved were also results of the balance test. In the experimental training of small circuits, exercises improving balance were included (i.e. single-legged jump on plyobox, bending shoulders on *bosu ball*). The use of this exercises should not only positively influence development of balance, but also functional muscle strength<sup>14</sup>. A confirmation of this observation are better results in the balance test after the training. Balance is an inseparable element, important for a warrior – modern one as well as the old one, perceived from the perspective of history of his development, his needs and needs of the team, which he is member of, and skills and predispositions indispensable for a fighter.

Effects of the strength exercises, even the well-chosen ones, additionally depend on chosen pace of performing them<sup>15</sup>. Morissey et al.<sup>16</sup>, examining an influence of a squat with a barbell on certain motor parameters, showed that the structure of squat movement may influence the strength, which the training person will generate. The authors noticed that exercises performed at a faster pace have given better results in final tests. Results of the experimental training confirms this observation, as improvement of the generated strength was stated clearly (test of long jump from standstill).

To examine the influence of the experimental training on special fitness of the participants, we have used a test of *speed of punches of upper limbs*<sup>17</sup>. On basis of the final

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*training on sprint, shuttle run, and vertical jump performance.* The Journal of Strength & Conditioning Research 19(3): 615-621.

<sup>14</sup> C.H. Heitkamp, T. Horstmann, F. Mayer, J. Weller, H.H. Dickhuth 2001: *Gain in strength and muscular balance after balance training.* International Journal of Sports Medicine 22(4): 285- 290.

<sup>15</sup> J. Munn, R.D. Herbert, M.J. Hancock, S.C. Gandevia 2005: *Resistance training for strength: effect of number of sets and contraction speed.* Medicine & Science in Sports & Exercise 37(9): 1622-1626.

<sup>16</sup> M.C. Morissey, E.A. Harman, P. N. Frykman, K.H. Han 1998: *Early phase differential effects of slow and fast barbell squat training.* The American Journal of Sports Medicine 26(2): 221-230.

<sup>17</sup> K. Sterkowicz 2003: *Testowanie sprawności specjalnej w Ju-Jitsu sportowym.* [w:] S. Sterkowicz, T. Ambroży (red.): *Ju-Jitsu sportowe: proces szkolenia (podręcznik trenera).* Wydawnictwo European Association for Security, Kraków.

results stated was an increase of the parameter of frequency of punches. This results confirm validity of replacing isolated exercises with complex plyarticular muscles work-out.

A basic rule of punching in kickboxing is smooth, coordinated engagement of a whole body<sup>18</sup>. Experienced boxers in their sport-jargon correcting their younger colleges often say: “punch him with your organism – not with your hand”. Only an amateur, who obviously should not be an antiterrorist claims that “you box with your hands”.

The set of exercises of the experimental work-out aimed to complex development of groups of muscles and improvement of their functionality.

High intensity of experimental unit of training caused that an average frequency of systole in groups of participants was oscillating at the range of 75-85% HR<sub>max</sub>. This range is considered the most optimal for adaptation of the organism to intense efforts<sup>19</sup>. Highest frequencies of the systole noted were at the range of 85-95% HR<sub>max</sub>, which suggests that the effort performed during the experimental training is submaximal. Tabata et al.<sup>20</sup> on the basis of their researches prove that a training of medium intensity only improves aerobic capacity. On the other hand trainings of high intensity improves both aerobic and anaerobic ways of the supply of oxygen. These reports confirms validity of the training form used.

In turn previous training specification used in the control group (“the own training”) also resulted in the development of motor skills, but to a lesser extent. It may prove that in sport training, one needs to modify intensity and form of training cycles to raise effectiveness. Claessens and Lefevre<sup>21</sup> claims that changes of physical activity,

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<sup>18</sup> T. Nowak 2004: *Boks technika, metodyka nauczania.* Wydawnictwo AWF Warszawa;

<sup>19</sup> R.R. Pate, J.D. Branch 1992: *Training for endurance sport.* Medicine & Science in Sports & Exercise 24(9): 340-343.

<sup>20</sup> I. Tabata, K. Nishimura, M. Kouzaki, I. Hiray, F. Ogita, M. Miyachi, K. Yamamoto 1996: *Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO<sub>2</sub> max.* Medicine & Science in Sports & Exercise 28(10): 1327-1330.

<sup>21</sup> A.L. Claessens, J. Lefevre 1992: *Secular trends in somatic and motor characteristics of physical education*

such as changing the training programs, may contribute to improvement of motor effects.

#### SUMMARY OF THE RESULTS. CONCLUSIONS

Analyzing the results and the available literature, following conclusions may be noted:

1. Regular training with load (except from isolated exercises) positively influences development of individual motor skills.
2. Properly designed training, level of which is relatively close to the structure of movement and kind of the effort, and selection of exercises, which develops groups of muscles associated to specialization, lead to improvement of effectiveness of performing motion tasks within the sport discipline trained, in this specific case the combat sport – *kickboxing*.
3. Increase of effectiveness of the training designed for antiterrorists and people, who trains combat sport is possible only through applying various training stimulus and optimized (within scientifically tested and confirmed in scientific experiments) method based on manipulating the intensity and volume of work-out by the trainer.

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